

() , ()

(VRA)

*

(// : // :)

(VRA)

(SSCM)

(DI)

(GPS)

()

()

%

(GPS)

(DI)

(VRT)

:

.(Al-Gaadi, 1992)

(VRA)

()

VRA

VRA

.(GopalaPillai, *et.al.* 1999)

(Gopala Pillai, *et al.*,

.1999)

()

(PWM)¹

(Gopala Pillai *et al.*, 1999)

(BBA, 2002)

Koo & (1990) Giles & Comino

Tian (1999) Gopala Pillai *et al.*, (1993) Kuhlman

(2000) & Zheng

km/h

r

VRA

) ()

(DI)

(

Frost (1990)

$$T_{\text{delay}} = \sum_{i=1}^n \frac{\pi L_i D_i^2}{4 Q_i}$$

()

) ()

(s)

: T_{delay}

(Stone *et al.*,

(

.1999)

(m)

: L_i

(m)

: D_i

(m³/s)

: Q_i

(DI)^r

: n

1 Pulse Width Modulation

2 Active Ingredient

3 Direct Injection

4 Carrier fluid

(Rockwell & Ayers, 1996)

(VRT)

)

(

(DI)

(T_R)

(DI)

(VRA)

)

()

(DI)

(

DI

()

()

(PLC)

(GPS)

()

()

()

-
- 1 Flow meter
 - 2 Pressure Sensor
 - 3 Rotary Encoder
 - 4 Programmable Logic Controller
 - 5 A to D Module
 - 6 Electrical Conductivity Sensor
 - 7 Differential Pressure Sensor

()

VDC

Hz

rpm

/ hp

L/min

Hz (PLC

(DC) *

PWM

DC

()

()

()

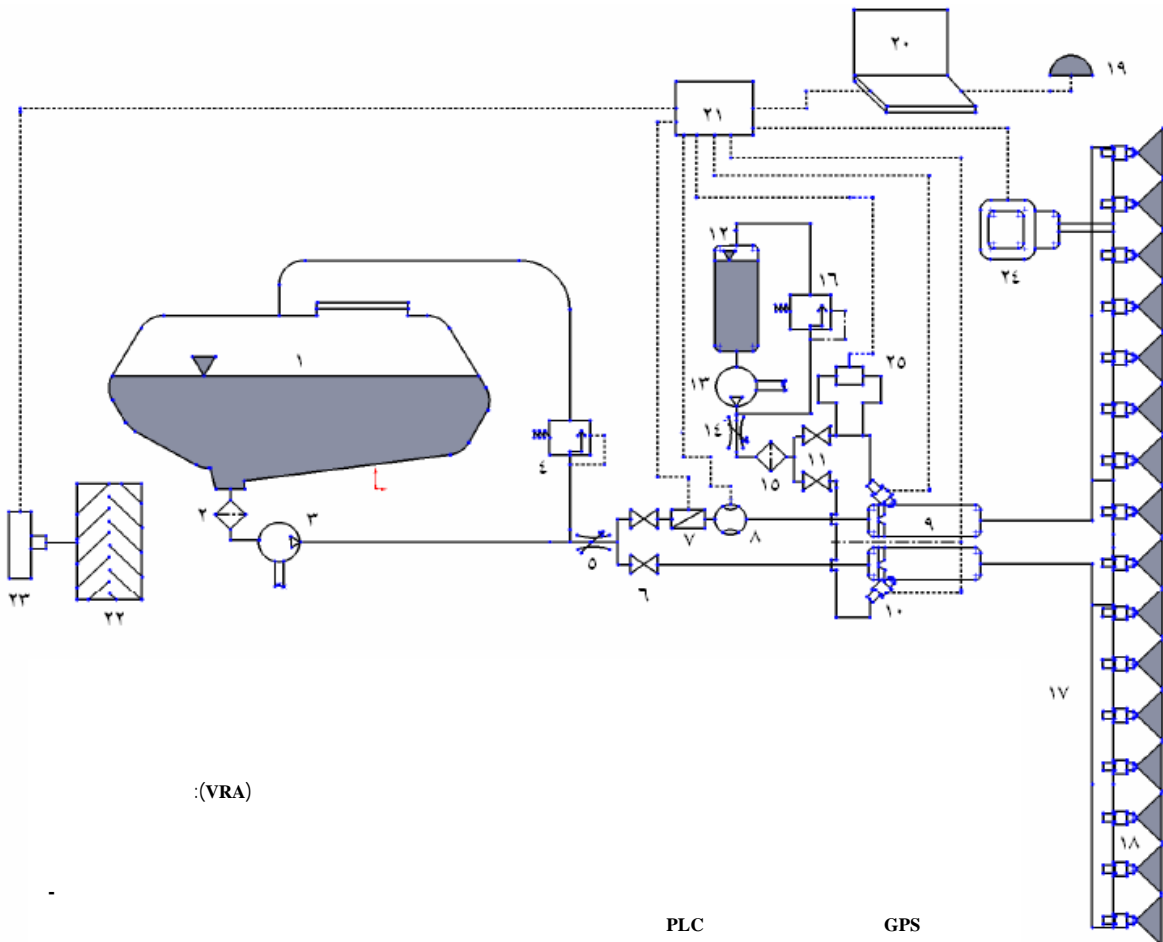
(PWM)

GPS

(Mohammadzamani et al., 2009)

2 چرخه‌ی وظیفه (Duty Cycle) یک موج به صورت نسبت " مدت پالس " به دوره-
ی تناوب پالس تعریف می شود.

1 Solenoid Injectors



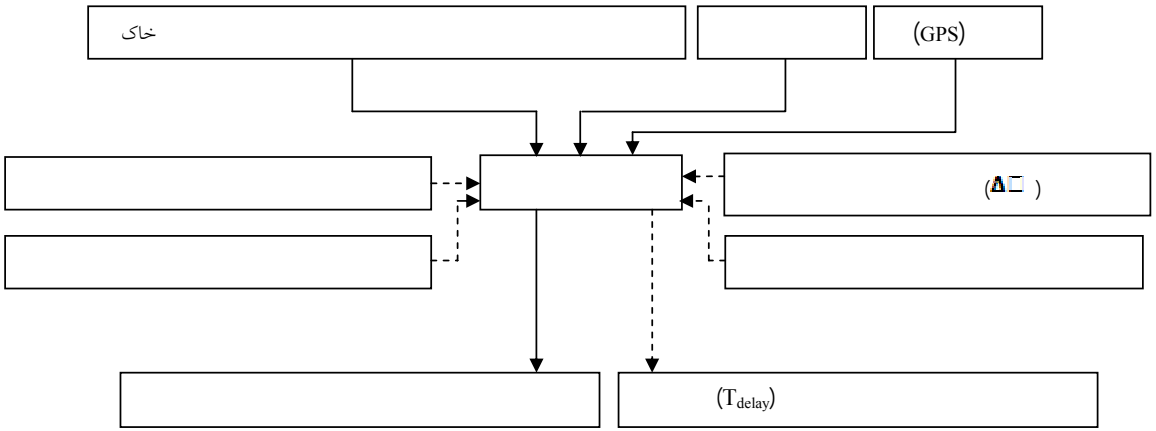
:(VRA)

PLC

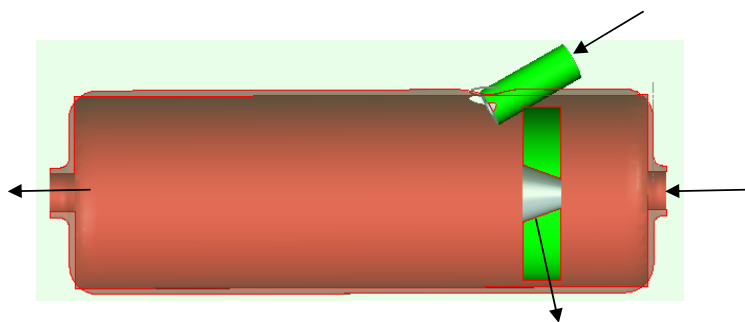
GPS



()



) () () VRA ()
(



cm

cm

. ()

C++Builder

Visual Basic WinProLadder

cm

cm

cm

()

FBs-24MC

FATEK

kHz

.()

kHz

(L₁)

(GPS)

)

NMEA

.(

()

L/min

.()

bar

USB

()

bar

)

.(

()

Burkert 8225 Compact Conductivity

Transmitter

K=1

mS/cm

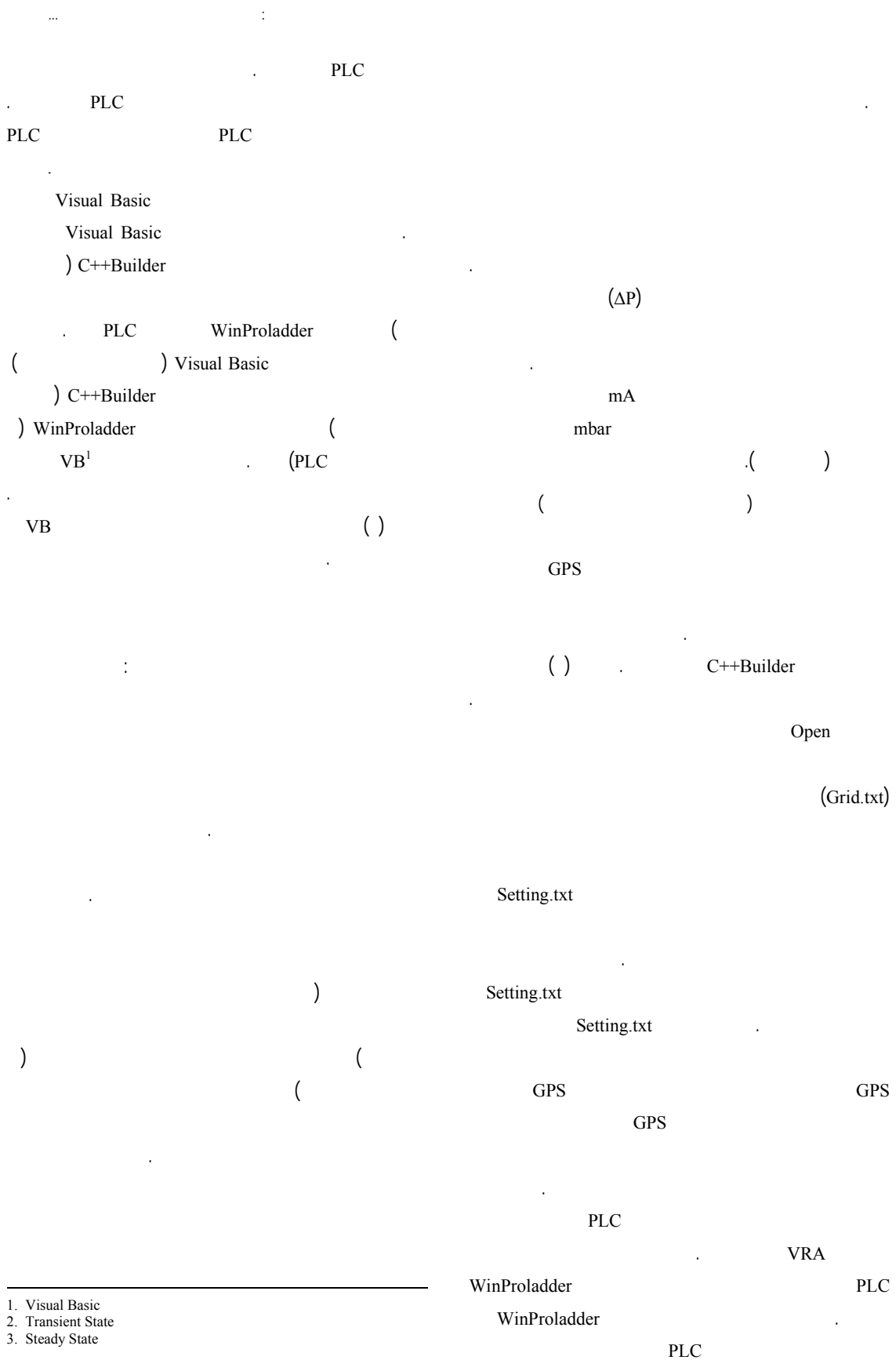
μS/cm

LCD

mA

.()

PLC



-
1. Visual Basic
 2. Transient State
 3. Steady State

WinProladder WinProladder
 VRA PLC
 PLC

()



GPS (PLC)

Form1

0 Start ●

0 Stop

Differential P	Duty Cycle	Speed
-0.5747	0	0

Conductivity	Water Flow	Water Pressure	Injection Flow
0	0	0	1.540700

Add Group Delete Group Delete Item Add Item

Write Connect Disconnect

VB

GPS Data

Open Latitude Coefficient 111177 Read Rate 1

Longitude Coefficient 90281

1 Flow Coefficient 100

Current Pos : Lat:36.24975204 Long:49.91075897

NearestPoint : idx:1731 Lat:36.24975204 Log:49.91075897 Flow:1.4697 Dist:0.0

Latitude 36.24975141 Longitude 49.91075803 Test

C++Builder

km/h

%

L/ha

SPSS 15

(km/h

(L/h

()

%

%

bar

bar

() () () ()

bar

D.C=2.5V.IF

()

(%)

: D.C

(km/h)

: V

%

(L/ha)

: IF

%

)

()

(

/ s

/ s

%

%

%

L/min

/ L/min

/

MATLAB

()

%

/ mS/cm (

)

F

/

/ *

/

/

/

/

/

%

*

%

()

%

bar

g/L

(s)	((bar)
/ ^a	
/ ^a	
/ ^a	

(/ / bar

s

()

(s)	((bar)
/ ^b	
/ ^a	
/ ^c	

()

cm

bar %

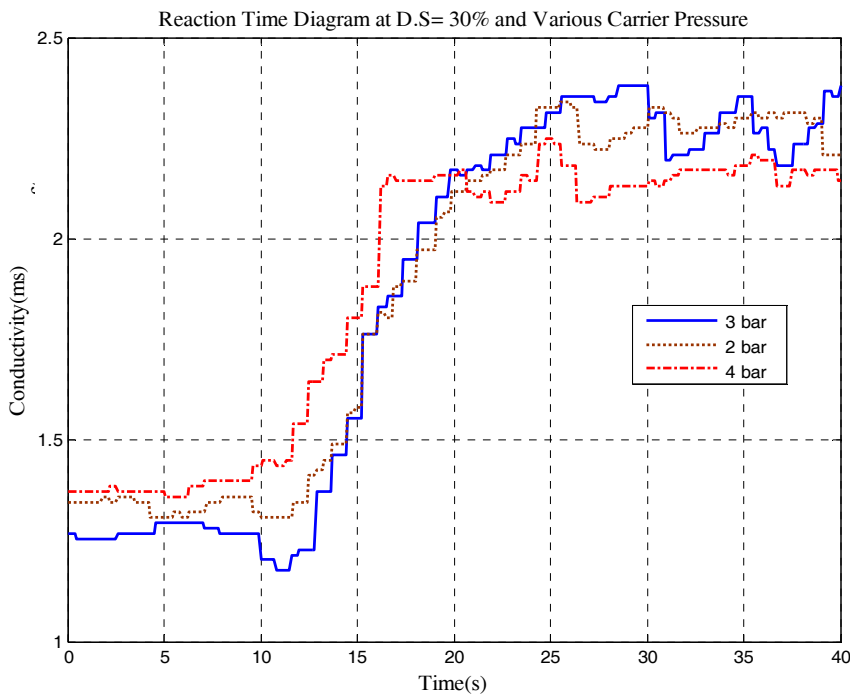
bar %

bar

bar

F			
/	/	ns	/
/	/		/
/	/		/

: ns



bar

km/h

%

)

bar

(L/ha

() ()

%

()

% (/ s)

%

F

/	/ *	/	/
		/	/
			/

% *

(s)	((cm))
/ ^a		
/ ^b		
/ ^c		

()

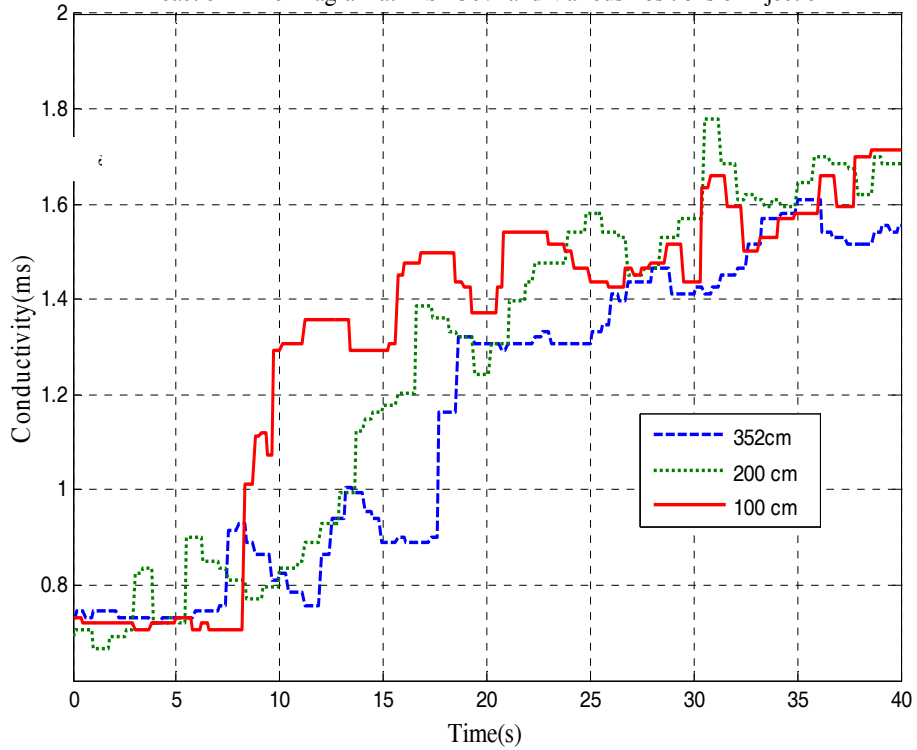
cm

cm

cm

(/ s)

Reaction Time Diagram at D.S= 30% and Various Positions of Injection



km/h

%

)

cm

(L/ha

bar

bar

, ()

()

bar bar

()

.

.

()

()

()

F

/	/	ns	/	/	
/	/	*	/	/	
/	/	ns	/	/	
	/	*	/	/	
/	/	ns	/	/	×
/	/	ns	/	/	×
/	/	ns	/	/	×
/	/	ns	/	/	×
			/	/	×
			/	/	×

:ns

%

:*

()

() :

(DI)

PWM

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